Jonathan Oladeji

Mr Jonathan (JD) Oladeji, PhD student, University of Pretoria, Private Bag X20, Hatfield 0028, South Africa. Phone: +27 63 528 0244, email: <u17046701@tuks.co.za>

Joseph Yacim

Dr Joseph (JA) Yacim, Lecturer, Federal Polytechnic, Nasarawa, PMB01, Nasarawa 962101, Nigeria. Phone: +234 805 327 6420, email: <joseph.yacim@gmail.com> ORCID: https://orcid.org/0000-0003-0651-3360

Kevin Wall

Prof. Kevin Wall, Department of Construction Economics, University of Pretoria, Private Bag X20, Hatfield 0028, South Africa. Phone: +27 12 420 2581
email: <kevin.wall@up.ac.za>

Benita Zulch

Prof. Benita Zulch, Department of Construction Economics, University of Pretoria, Private Bag X20, Hatfield 0028, South Africa. Phone: +27 12 420 2581,
email: <Benita.zulch@up.ac.za> ORCID: https://orcid.org/0000-0001-8777-2510

DOI: http://dx.doi.org/10.18820/24150487/as27i2.4

ISSN: 1023-0564

e-ISSN: 2415-0487

Acta Structilia 2020 27(2): 93-119

OPEN ACCESS

Published by the UFS

http://journals.ufs.ac.za/index.php/as

How to cite: Oladeji, J., Yacim, J., Wall, K. & Zulch, B. 2020. Macroeconomic leading indicators of listed property price movements in Nigeria and South Africa. *Acta Structilia*, 27(2), pp. 93-119.

MACROECONOMIC LEADING INDICATORS OF LISTED PROPERTY PRICE MOVEMENTS IN NIGERIA AND SOUTH AFRICA

Peer reviewed and revised August 2020

Published December 2020

**The authors declared no conflict of interest for the article or title*

ABSTRACT

This article aims to identify macroeconomic leading indicators that influence changes in the listed property price movements in South Africa and Nigeria. This serves to improve the quantitative approaches to investment appraisal in emerging markets of sub-Saharan Africa. The data relating to macroeconomic leading indicators, including Johannesburg Stock Exchange (JSE) Listed Property (J253) quarterly price data, Nigerian listed real-estate data, and Macroeconomic indicator series for Nigeria and South Africa, were collected from Iress Expert Database, Stats SA, the Central Bank of Nigeria (CBN), the National Bureau of Statistics (Nigeria), and the World Bank. The article identifies that coincident indicators and the exchange rate have a positive and significant relationship with the JSE-listed real estate in the South African market. While the bank lending rate, the consumer price index, and the Treasury bill rate (TBR) are identified as reliable indicators in the Nigerian listed real-estate market. The results show that investors must pay attention to these indices in their choice

of the market(s) within the sub-Saharan African context, as this will guarantee capital appreciation or growth.

Keywords: Indicators, investment, listed property, macroeconomic, price

ABSTRAK

Hierdie artikel het ten doel om makro-ekonomiese leidende aanwysers te identifiseer wat die veranderinge in die genoteerde eiendomsprysbewegings in Suid-Afrika en Nigerië beïnvloed. Dit help om die kwantitatiewe benaderings tot beleggingsbeoordeling in opkomende markte in Afrika suid van die Sahara te verbeter. Die gegewens rakende makro-ekonomiese leidende aanwysers, insluitend die kwartaallikse prysdata van die Johannesburgse Effektebeurs (J253), die Nigeriese vaste eiendomsdata en die makro-ekonomiese aanwyserreeks vir Nigerië en Suid-Afrika is versamel van Iress Expert Database, Stats SA, die Central Bank of Nigeria (CBN), die National Bureau of Statistics (Nigeria) en die Wêreldbank. In die artikel word aangedui dat samevallende aanwysers en die wisselkoers 'n positiewe en beduidende verband het met die JSE-genoteerde vaste eiendom in die Suid-Afrikaanse mark. Terwyl die bankleningsyfer, die verbruikersprysindeks en die skatkis (TBR) as betroubare aanwysers in die Nigeriese genoteerde eiendomsmark geïdentifiseer word. Die resultate toon dat beleggers aandag moet skenk aan hierdie indekse in hul keuse van die mark(te) binne Afrika suid van die Sahara, aangesien dit kapitaalappresiasie of groei sal waarborg.

Sleutelwoorde: Aanwysers, belegging, genoteerde eiendom, makro-ekonomies, prys

1. INTRODUCTION

The real-estate sector significantly contributes to the gross domestic product (GDP) of countries worldwide. Therefore, several countries pay special attention to making this sector attractive to both local and international investors. According to the Organisation for Economic Co-operation and Development (OECD) (2018), real estate contributes a total of 2.3 trillion US Dollars to GDP in the United States of America (USA); 404.9 billion US Dollars in the United Kingdom (UK); 151.3 billion US Dollars in Australia, and 191.4 billion US Dollars in Canada. However, in comparison to these major economies, the contribution of real estate to GDP in sub-Saharan Africa's emerging markets is marginal (Bodunrin, 2019). In particular, real estate contributed 0.8%, representing roughly 40 billion Rands (2.8 billion US Dollars), to South Africa's GDP in 2018 (SA Commercial Prop News, 2019), while the real-estate sector contributes 6.85%, representing approximately 9.4 trillion Naira (25.9 billion US Dollars), to the Nigerian GDP (BudgIT, 2018).

Although there is a marginal growth in the contribution of the real-estate sector to GDP in South Africa and Nigeria, this is attributable more to additional stream from development finance institutions (DFI), sovereign wealth funds (SWF), and foreign direct investment (FDI) (PwC, 2015: 85). However, since the safety of investor(s) capital or income is foremost in decision-making, real-estate market participants are particularly interested in knowing the future trajectory of rent or price relative to their choices.

There are a considerable number of studies on finding the future direction of rent or price (Karakozova, 2004: 51; Tsolacos, Brooks & Nneji, 2014: 541; Michael & Almeida, 2016; Harrami & Paulsson, 2017). However, most of these studies were carried out in mature or more developed real-estate markets, where there is relative economic stability and historical real-estate transaction data are readily available. Consequently, due to differential contextual settings and market behaviour of real-estate markets, findings from these studies could not be used to make significant inferences about other markets, especially the emerging markets.

Accordingly, the different contextual market settings in the two sub-Saharan African countries, Nigeria and South Africa, necessitate an investigation into the real-estate market behaviours. In Nigeria, particularly in Abuja, the nation's capital city, a high vacancy rate for real estates is reported in several locations (Namnso, Ighalo & Sanusi, 2015: 64). In addition, the recent security situation in some parts of Nigeria is a negative strain on investors' confidence in the real-estate market. In South Africa, the recent spate of xenophobic occurrences in some parts of the country is cause for concern to foreign investors in the real-estate market. It, therefore, becomes important to evaluate the responses of the real-estate market to recent changes in the overall economies. On the surface, the challenges might seem to scare investors from committing their funds into the markets; however, these could not be substantiated without a careful analysis of the leading economic indicators across the two countries.

The motivation in this study is to use the indicators to unravel perceived economic consequences of the changes on real-estate investment returns. In addition, to comparatively identify the leading market indicators across these two top economies is *sine qua non* for real-estate investment decisions. Consequently, the place of these countries in the African continent serves as an avenue for useful information on market indicators to be marginally applied across the rest of sub-Saharan Africa. It is, therefore, important to identify the key market determinant variables that forecast timeous recognition of turning points in commercial real-estate rents in Nigeria and South Africa. In order to analyse the turning points, Tsolacos *et al.* (2014: 541) review related studies on reliable real-estate market indicators. The identification of market indicators is used to understand advance market behaviour of different periods of positive or negative growth in rents.

2. LITERATURE REVIEW

This study was premised on the possibility that macroeconomic factors could drive real-estate prices and thus provide insight for better investment decision-making. Leading indicators signal the fluctuations in markets that

manifest as expansions or contractions. Accordingly, several technique(s) have been used to test the leading indicators, in order to reflect market performance or to predict business variations. This is achieved by means of repetitive patterns that reveal a state of growth or reduced economic activity (Krystalogianni, Matysiak & Tsolacos, 2004).

Clark and Daniel (2006) listed eleven leading economic and financial indicators for forecasting South African house prices: all share index, prime interest rate, gross domestic product, building plans, business confidence, motor vehicle sales, household debt/disposable income, Rand/Dollar exchange rate, gold prices, oil prices, and transfer costs. Akinsomi, Mkhabela and Taderera (2018) as well as Sibanda (2013) considered the macroeconomic drivers of direct real-estate returns, and found that GDP, interest rate, and unemployment are statistically significant drivers of direct real-estate returns in South Africa.

The opportunity to deliver greater insight into these relationships promises better understanding of real-estate investment risks and enhances investment confidence (Ntuli & Akinsomi, 2017; Emerole, 2018). According to Boshoff and Binge (2019), investment confidence indicators possess analytical signals for economic growth and are frequently accurate leading indicators and useful for detecting early warning signals for economic turning points (Krystalogianni *et al.*, 2004). Boshoff (2013) opines that the information provided by indirect real-estate investment shows that analysts can rely on these data for evaluating markets, because real estate at this level is like any other asset class and could be influenced by various economic and financial drivers.

The leading nature of some macroeconomic indicators has been found to serve as early warning signals of imminent significant changes in the direction of the real-estate market. Accordingly, D'Arcy, McGough and Tsolacos (1999) carried out a study of the Dublin office rental market and found that changes in real gross domestic product (GDP) and service sector employment (SSE) are significant determinants of the demand and pricing for office space. Similarly, MacFarlane, Murray, Parker and Peng (2002) identified employment as the primary driver of demand for office space in Sydney, Australia.

Krystalogianni *et al.* (2004) examined the future trajectory of real-estate prices in the United Kingdom's (UK) industrial, office and retail properties, and found gilt yield and broad money supply (M4) as key market indicators for the direction of the real-estate markets. Karakozova (2004) undertook a study in Finland to identify the drivers and the best methods for modelling and forecasting property returns and concluded that the leading indicators for predicting commercial rents are growth in service-sector employment, GDP, and output from financial and business services. Ng and Higgins

(2007) in the United States of America (USA) investigated the critical determinants of the commercial real-estate market performance. They found the GDP, the unemployment rate, as well as office finance, insurance and real-estate services (FIRE) employment as leading indicators.

In a related study in the USA, Baba and Kisinbay (2011) found labour market, housing, yield spreads, and consumption to be determinants that lead to changes in the market. Similarly, Harrami and Paulsson (2017) investigated rent modelling for the Swedish office market and found that the GDP was useful in predicting the direction of the real-estate market. Similar studies in the UK and the USA (Füss, Stein & Zietz, 2012; Tsolacos, 2006; Frankel & Saravelos, 2012; Buehler & Almeida, 2016) report that, in order to create predictive models, identifying the "right" set of variables that combine to trigger changes in the market was the first step. In particular, Buehler and Almeida (2016), noted that the risk of downturns in the commercial real-estate prices in USA cities was attributable to several macroeconomic indicators, including inflation rates, bond yields, consumer confidence, and employment.

These studies attempt to provide models for forecasting real-estate price movement in highly developed and well-structured markets. The importance of this study is underscored in Tsolacos and Brooks (2010), who suggested that research on early warning signals for real-estate markets should be predicated, using the leading macroeconomic indicators. Leading indicators are used to capture changes in direction and turning points. Thus, as noted earlier, security challenges witnessed in Nigeria and South Africa, though difficult to directly capitalise, could be modelled on the leading market indicators.

Consequently, there is a paucity of literature on identifying the leading macroeconomic indicators in the Nigerian and South African real-estate markets. Namnso *et al*. (2015) undertook a study of the drivers of office rent in three districts in Abuja, Nigeria, and found that real GDP growth and the vacancy rate were significant determinants of rental growth. In the real-estate market, Mourouzi-Sivitanidou (2020) undertook a study to identify leading macroeconomic drivers of the market direction and found employment, retail sales/wholesale trade sales, GDP (by sector), manufacturing production/factory utilisation, consumer price index (CPI), and producer price index (PPI) inflation as determinants. Clark and Daniel (2006) also attempted to develop an econometric model for forecasting South African house prices for 2005/2006. The study found a positive relationship between lagged stock market returns, GDP, transfer costs, and house price growth rates, while a negative relationship exists between interest rates, exchange rate movements, and house-price growth rates.

Monde (2008) reports that the first mark of an imminent turning point in the business cycle is typically when the composite leading business cycle indicator changes course for at least six months. The study suggests that interest rates play a significant role in the South African real-estate sector, but that it is challenging to carry out a sector-specific analysis of macroeconomic interactions. Akinsomi, Mkhabela and Taderera (2018) considered the macroeconomic drivers of direct real-estate returns in South Africa and found the GDP, interest rate, and unemployment as significant drivers of real-estate returns. Despite macroeconomic variables playing a substantial role in understanding the growth and performance of real estate, modelling this relationship still poses a considerable challenge.

Clear identification of leading economic indicators and modelling of turning points should provide insight into the changes and direction in the commercial real-estate markets. It thus seeks to investigate how much forecasting accuracy can be achieved by modelling the relationships between listed real estate and macroeconomic time series. Tsolacos *et al*. (2014) observed that the choice of modelling tools was particularly crucial in achieving accuracy, and thus suggested the use of a probit model and a Markov switching model. Therefore, in addition to the comparative analysis of the commercial real-estate macroeconomic indicators that this study undertook between the two leading economies in Africa, the logit techniques employed add to its uniqueness from a pan-African perspective.

3. METHODOLOGY

In identifying reliable indicators for modelling the probability of turning points, this study employed a quantitative content analysis and the use of inferential statistics, as noted in Frankel and Saravelos (2012). Through content analysis, macroeconomic indicators and commercial real-estate market information were identified and then tested. The study investigated the relationship between the identified macroeconomic (independent) variables and the listed real-estate (dependent) variable, using the correlation and logistic regression statistical measures. Similar studies that informed the use of these methodologies included Krystalogianni *et al.* (2004), Tsolacos (2012), Tsolacos and Brooks (2010); Buehler and Almeida (2016), and Moolman and Jordaan (2005).

3.1 Data collection

The indicators and sources identified in the literature review were examined for preliminary selection of the independent variables. The dependent variable was extracted from the listed real-estate indices found in this investigation. The major sources of relevant data in South Africa and

Nigeria included the South African Reserve Bank; Statistics South Africa; IRESS Expert, and the Central Bank of Nigeria (CBN) statistic database.

Other data sources such as the Amalgamated Bank of South Africa (ABSA) real-estate data, the data from the JSE website and others were inaccessible or insufficient, sometimes only providing 1 to 5 years of time-series data. FTSE/JSE SA Listed Property (J253) quarterly price data were, however, extracted from the Iress Expert database. The Nigerian REIT time-series data used were sourced from the Union Homes, Skye Shelter, and UACN Properties. The historical data available covered ten years as compared to fifteen years' data that were collected for South Africa. With respect to the Nigerian data, the analysis examines the Nigerian Stock Exchange (NSE) instruments for the availability of a commercial real-estate data series. The NSE listed RE index developed is a proxy for the listed real-estate indicator that was not provided in the NSE index database.

There was a limitation on the selection of time series for dependent and independent variables, in that the longest series available for some South African macroeconomic indicators was from Quarter 1 of 2003 to Quarter 4 of 2018. Jadevicius, Sloan and Brown's (2013) study suggests that the FTSE/JSE SA Listed Property (J253) is the only available real-estate data that spans to the required 15 years. The availability of data spanning the required period served as a basis for selecting the real-estate time series adopted as the dependent variable. The FTSE/JSE Property Loan Stock (J256) and FTSE/JSE Real Estate Investment Trusts (J867) were thus excluded from the analysis. This implied that other series not meeting this range were invalid for consideration. Missing data for quarters not exceeding 1-5 quarters were replaced with the closest available data. Olanrele, Adegunle, Fateye and Ajayi (2019) noted the limitation of using other Nigerian REIT (N-REIT) data such as Smart Products Nigeria Plc (SMURFIT) and UPDC REIT because of their recent establishment. Thus, the weighted average of Sky Shelter REIT (SKY REIT) and the UACN property development company data served as a proxy for the listed real-estate sector. Accordingly, the available data for the Nigerian listed real-estate market were collected for the period 2008: Q1 to 2018: Q4.

3.2 Data analysis and interpretation of data

Descriptive statistic measures employed included the Minimum, Maximum, Median and Standard Deviation. All monthly data were converted into quarterly data before analyses to ensure uniformity with the exogenous data. These indicators were set as the variables tested in the two models (South Africa and Nigeria). In this study, several statistical tests and indicators were used to analyse and evaluate the accuracy, applicability, and statistical significance of the logistics model(s).

3.2.1 The chi-square and significance level

The model's *chi*-square statistic and its significance level present the first test of model performance. A significant p-value is compared to a critical value, perhaps .05 or .01, to determine whether the overall model is statistically significant. The value given in the Sig. column is the probability of obtaining the *chi*-square statistic, given that the null hypothesis is true (NCSS, 2020). This test was used to indicate whether there is a significant association between the dependent listed real-estate variable and the other independent variables.

3.2.2 The omnibus test of model significance

This is a test for the performance of the independent variables over the null model with only the intercept. This test evaluates how much of the variance in the dependent variable is explained by changes in the independent variables (NCSS, 2020). This test was used to evaluate how much of the change that occurs in the dependent listed real-estate variable is accounted for by the independent variables in the model.

3.2.3 Cox & Snell R-square and Nagelkerke R-square

These are pseudo R-squares. These R-squared values test the model's goodness of fit. The Cox & Snell R 2 can be interpreted like the R-squared in a multiple regression, but cannot reach a maximum value of 1. The Nagelkerke R-squared can reach a maximum of 1 (NCSS, 2020). This test measured how well the model derived fits the data and classifies the outcomes of the predictive model.

3.2.4 Hosmer-Lemeshow test

A second test for the model's goodness of fit is the Hosmer-Lemeshow test. This tests the null hypothesis that predictions made by the model will fit perfectly with observed group memberships. The higher the value of this test, the better the goodness of fit (NCSS, 2020). The test helps identify the relative performance of the models in predicting the future direction (rise or fall) of the listed real-estate market.

3.3 Model description

3.3.1 Dependent variable used in the model(s)

The Nigerian REIT and JSE time-series data are used to create dummy binary outcomes for the purpose of logistic regression. The time-series data difference of Yt-Yt-1 was classified based on a rise or fall. A growth in the time series represented a 0., while a fall represented a 1. This provided the

data for the binary variable in both data sets. The South African dummy variable is denoted as South Africa Listed Real Estate (SALRE), while the Nigerian dummy variable is denoted as Nigeria Listed Real Estate (NLRE). The Iress Expert Database provided the three top real-estate instruments, including FTSE/JSE Property Loan Stock (J256), FTSE/JSE Real Estate Investment Trusts (J867), and FTSE/JSE SA Listed Property (J253). The FTSE/JSE SA Listed Property (J253) proved to be the only real-estate variable spanning to the required 15 years, as suggested in Jadevicius *et al.* (2013).

3.3.2 Independent variables used in the model(s)

The South African macroeconomic variables that were evaluated, included the GDP at market prices (R million), Percentage CPI Consumer prices: CPI, excluding food and non-alcoholic beverages and fuel (all urban areas), manufacturing (2015=100), leading indicator (2015=100), coincident indicator (2015=100), lagging indicator (2015=100), M0, M1A, M1, M2, total monetary (M3) deposits, exchange, interest rates, and the gold price.

The leading indicator (2015=100), coincident indicator (2015=100), and lagging indicator (2015=100) are further explained in Van Der Walt and Pretorius (2004: 29-35) as follows:

3.3.2.i The leading indicator series

This is composed of: Opinion survey of volume of orders in manufacturing; opinion survey of stocks in relation to demand (manufacturing and trade); opinion survey of business confidence (manufacturing, construction, and trade composite); leading business cycle indicator of major trading-partner countries (percentage change over twelve months); commodity prices in US Dollars for a basket of South Africa's export commodities (six-month smoothed growth rate); real M1 money supply (deflated with the CPI): six-month smoothed growth rate; prices of all classes of shares (six-month smoothed growth rate); number of residential building plans passed for flats, townhouses, and houses larger than 80m^2; interest rate spread (10-year bonds less 91-day treasury bills); gross operating surplus as a percentage of gross domestic product; labour productivity in manufacturing: (six-month smoothed growth rate); job advertisements in the *Sunday Times* newspaper (six-month smoothed growth rate), and opinion survey of the average hours worked per factory worker in the manufacturing sector

3.3.2.ii The coincident indicator series

This is composed of: Gross value added at constant prices, excluding agriculture, forestry and fishing; value of wholesale, retail and new vehicle

sales at constant prices; utilisation of production capacity in manufacturing; total formal non-agricultural employment, and industrial production index.

3.3.2. iii The lagging indicator series

This is composed of: Employment in non-agriculture sector; total number of hours worked by production workers in the construction sector; physical volume of mining production of building materials; value of unfilled orders as percentage of sales in manufacturing; value of fixed investment in machinery and equipment; value of non-residential buildings completed; value of commercial and industrial inventories at constant prices, and labour cost per unit of the physical volume of manufacturing production.

Nigerian macroeconomic variables included the total GDP, prime lending/ interest rate (%), the Treasury bill rate (%), the total money asset, money supply (M1), currency in circulation, and money supply (M2).

3.4 Logit modelling

The logit model provides the best fitted combination of macroeconomic variables that improves on the null/naïve model. The probabilities are summed up or down between 0 and 1 to provide the forecast based on thresholds such as 0.5, 0.7, 0.9.

T; being the state of the independent variable is estimated to be 1 or 0, based on the logit regression rule:

T = 1 for the period that capital values decline
T = 0 otherwise

Therefore, the objective of using a logit approach is to estimate a response probability:

$Pr (T = 1|x) = Pr (T = 1| x1, x2, ..., xk)$
$Pr (T = 1|x) = \log(p/1-p) = \beta0 + \beta1x1 + \ldots + \beta kxk$

In Equation 1, the coincident indicator $\beta = 0.479$, while the exchange rate was $\beta = 0.083$. The constant or intercept value was -74.738.

The South African logit model is expressed as:

$$Y = Pr (T = 1|x) = \log(p/1-p) = -74.738. + 0.479CI + 0.083ER \quad \text{Equation 1}$$

Where:

Y = Binary variable outcome
Pr = Probability
β0 = Model intercept
βx= Regression coefficient
CI = Coincident indicator
ER = Exchange rate

For Nigeria, the coefficient for variables in the equation is summarised in the logit regression equation as:

Y = Pr (T = 1|x) = log(p/1-p) or *ln* (ODDS)
log(p/1-p) or *ln* (ODDS) = -21.938 + 0.143(IR) - 0.037 (TBR) - 0.034 (CPI
Equation 2

Where:

Y = Binary variable outcome
Pr = Probability
IR = Lending/interest rate
TBR = Treasury bill rate
CPI = Consumer price index

4. RESULTS AND DISCUSSION

4.1 South African model

Dependent variable: South Africa Listed Real Estate (SALRE)

Independent variables: GDP at market prices (R million), Percentage CPI Consumer prices: CPI, excluding food and non-alcoholic beverages and fuel (all urban areas), manufacturing (2015=100), leading indicator (2015=100), coincident indicator (2015=100), lagging indicator (2015=100), M0, M1A, M1, M2, total monetary (M3) deposits, exchange, interest rates, and the gold price.

Descriptive statistics for the South African regression model are presented in Table 1. The prime lending rate and Treasury bill data are presented as percentages, while other indicators present as actual figures. Table 1 provides information about the nature of the data used for the logistic regression.

The South African FTSE/JSE SA Listed Property (J253) is the annual capitalization of listed real estate on the JSE. The indicator shows a minimum and maximum value of R24,905,288,373 (USD1,451,472,927.71) and R585,250,954,031 (USD34,108,254,558.04, respectively with a mean of R196,738,877,374 (USD11,450,422,969.30). Its standard deviation of R161,566,289,587 (USD9,416,036,138.72) represents a large dispersion of the values from the mean.

The percentage CPI consumer prices has a standard deviation of 3.09, a mean of 4.33, and a range of -11.20 and 9.20. These values represent the possibilities for the investment to generate higher real-estate returns.

The mean of the SALRE at 0.70 and a 0.460 standard deviation suggests that a growth is more frequently recorded in the time series with the maximum (1) than the fall as recorded by the minimum (0). Interest rates show a standard deviation from the mean of 6.31% with a maximum of 51% and a 25.5% minimum and a 32.56% mean value. Meanwhile, the GDP maximum stands at 1,236,403 (R millions). GDP also has a minimum

Table 1: Descriptive statistics of South African data employed in logit analysis

	Minimum	*Maximum*	*Mean*	*Std. deviation*
FTSE/JSE SA Listed Property (J253)	24905288373	585250954031	196738877374	161566289587
Binary variable (SALRE)	0	1	.70	.460
GDP @ market prices (R million)	317548.00	1236403.00	743515.90	283143.52
Percentage CPI consumer prices	-11.20[1]	9.20	4.33	3.09
Manufacturing (2015=100)	87.77	108.40	98.22	4.32
Leading indicator (2015=100)	86.87	108.40	102.10	4.49
Coincident indicator (2015=100)	69.43	103.67	90.68	10.28
Lagging indicator (2015=100)	94.53	124.37	101.37	6.46
M0	59579.67	250307.67	144681.46	60638.57
M1A	220759.67	848555.67	501334.74	202849.47
M1	395897.00	1726139.67	947969.44	413235.46
M2	746724.33	2830701.67	1704159.54	640799.34
Total monetary (M3) deposits	833366.00	3508983.00	2090677.05	818284.46
Interest rates	25.50	51.00	32.56	6.31
Price of gold per ounce (Rand)	7664.75	56662.66	30071.49	16290.20
Exchange rates	212.05	312.30	267.04	24.21

1 Negative inflation/deflation is not uncommon situation and has been reported in the South African economy in time past. However, this study reports year on year CPI Consumer prices/inflation which could be a growth or a fall. A negative annual CPI (year on year) implies that the government's effort to control inflation led to a major fall in money supply and a deflationary trend. According to the Research Department and Information Division (2007), when setting monetary policy, the Bank decides on the level of short-term interest rates necessary to meet the inflation target. This can be increased and decreased to respond to the inflation levels at a certain time. Inflation in 1995, as reported by Department of Finance, Republic of South Africa (RSA) (n.d.), declined to levels last seen in the early 1970s. The annual rate of increase in consumer prices has been below 10 percent for three years prior to it.

of 317,548 (R millions), a mean and standard deviation of 743,515.90 (R millions), 283,143.52 (R millions), respectively. The high standard deviations indicate the growth or change over the time period include values that are significantly dispersed from the mean values. These values capture peaks and troughs in the time series and should as such demonstrate significant deviations from a mean value.

A logistic regression model with all 14 selected South African leading indicators was compared to the effect of selectivity, excluding variables with insignificant p-values from the model (Tables 2 and 3). Multivariate logit regression is performed to evaluate the perfect combination of independent variables for predicting the probability of a decline or rise (Table 4).

Table 2: Spearman correlation of South African economic (money supply) indicators with the dependent listed real-estate variable

			M0	*M1A*	*M1*	*M2*	*Total monetary (M3) deposits*	*Interest rates*	*Price of gold per ounce (Rand)*	*Exchange rates*
Spearman's rho	FTSE/JSE SA listed property (J253)	Correlation coefficient	.986**	.986**	.987**	.984**	.985**	.591**	-.974**	.580**
		Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000
		N	64	64	64	64	64	64	64	64

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

A Spearman's correlation was run to assess the relationship between South African economic (money supply) indicators and FTSE/JSE SA Listed Property (J253), using a sample of 64 indicators. In Table 2, from the South African data analysed, all money supply variables show a strong positive correlation with the listed real estate indicator, where M0 [rs=.986, p<.001], M1A [rs=.986, p<.001], M1 [rs=.987, p<.001], M2 [rs=.984, p<.001] M3 [rs=.985, p=.000] was statistically significant. There was a moderate correlation between interest [rs=.591, p<.001] and exchange [rs=.580, p=.000] rates and FTSE/JSE SA Listed Property (J253). Although the price of gold per ounce showed significant value as an indicator [rs=-.974, p=.000], there is a strong negative correlation with FTSE/JSE SA Listed Property (J253).

Table 3: Spearman correlation of South African economic indicators with the dependent listed real-estate variable

			FTSE/JSE SA listed property (J253)	*GDP at market prices (R million)*	*% CPI*	*Manufacturing (2015=100)*	*Leading indicator (2015 = 100)*	*Coincident indicator (2015=100)*	*Lagging indicator (2015=100)*
Spearman's rho	FTSE/JSE SA listed property (J253)	Correlation coefficient	1.000	.984**	.342**	.450**	.230	.948**	-.471**
		Sig. (2-tailed)	.	.000	.006	.000	.067	.000	.000
		N	64	64	64	64	64	64	64

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

In Table 3, GDP at the market price indicated a strong correlation with the dependent FTSE/JSE SA Listed Property (J253) indicator, which was statistically significant, rs=984, p=000. The CPI indicator was not significant and showed a relatively low correlation [rs=.342, p=.006] with FTSE/JSE SA Listed Property (J253), indicating almost no relationship between product prices or inflation and the listed real-estate market. Although manufacturing showed significant value as an indicator [rs=.450, p<.001], there is a weak correlation with FTSE/JSE SA Listed property (J253).

With rs=.230, p=.067, the leading indicator failed to show any level of significance and no existence of any linear relationship with the listed property data. There was a strong positive correlation between the coincident indicator and FTSE/JSE SA Listed Property (J253), which was statistically significant, rs=.948, p<.001. Although the lagging indicator was a significant indicator, [rs=-.471, p<.001], it shows a weak negative correlation with the listed property data.

There was some degree of collinearity between the money supply variables M0, M1, M1A, M2, M3, the coincident indicator, and GDP. However, they all indicate a level of significance p<0.05, except for the leading indicator which had no significant relationship with most of the other independent variables. Most of the variables with collinearity have a significant impact on the output J253 listed real-estate pricing variable, hence they could not be excluded randomly. The binary logistic modelling process solves the problems of collinearity, by excluding variables that do not contribute significantly to the model derived. In Table 4, the logit model provides the best fitted combination of macroeconomic variables that improves on the

null/naïve model. The probabilities are summed up or down between 0 and 1 to provide the forecast based on thresholds such as 0.5, 0.7, 0.9. These thresholds are arbitrary and thus require the analyst understanding of the market's sensitivity to changes in these economic variables.

Table 4: Significant indicators accepted in the South African logistic regression

Indicator	*B (beta)*	*S.E. (standard error)*	*Wald*	*Df*	*Sig.*
GDP at market prices (R million)	.000	.000	.215	1	.643
Coincident indicator (2015=100)	.479	.156	9.467	1	*.002
M0	.000	.000	1.509	1	.219
M1A	.000	.000	.403	1	.526
M1	.000	.000	1.135	1	.287
M2	.000	.000	.523	1	.469
Total monetary (M3) deposits	.000	.000	.169	1	.681
Price of gold per ounce (Rand)	.000	.000	3.409	1	.065
Exchange rates	.083	.032	6.598	1	*.010
Constant	-74.738	28.311	6.969	1	.008

* significant at the 0.05 level

In Table 4, the Wald Z-test shows the values are not zero, which confirms that the selected indicators are significant and should be included in the model. The β (beta coefficient) allows comparison of **the relative importance** of indicators in a regression model. GDP (β=0.000, p=.643), M0 (β=0.000, p=.219), M1A (β=0.000, p=.526), M1 (β=0.000, p=.287), M2 (β=0.000, p=.469), M3 (β=0.000, p=.681), and price of gold (β=0.000, p=.065) have zero influence on, and do not predict the listed real-estate market. The β values for South African data sets show that coincident indicators (β = 0.479, p=.002) and exchange rates (β=0.083, p=.010) are significant indicators and predict the listed real-estate market trends in South Africa. This signifies that an increase in these two economic indicators will impact positively towards growth in the listed real-estate market.

The tests for significance of the South African model are shown in Tables 5 to 8.

Table 5: Omnibus test of Logit Regression Model for indicators with a strong negative or positive correlation with the FTSE/JSE J253 indicator (r≤0.05)

	Chi-square	*df*	*Sig.*
Step	18.928	9	.026
Block	18.928	9	.026
Model	18.928	9	.026

Table 6: Pseudo-R values of Logit Regression Model for indicators with a strong negative or positive correlation with the FTSE/JSE J253 indicator (r≤0.05)

-2 Log likelihood	*Cox & Snell R Square*	*Nagelkerke R Square*
58.920a	.256	.364

Table 7: Hosmer and Lemeshow goodness of fit test of Logit Regression Model for indicators with a strong negative or positive correlation with the FTSE/JSE J253 indicator (r≤0.05)

Chi-square	*Df*	*Sig.*
5.010	8	.757

Table 8: Classification table of Logit Regression Model for indicators with a strong negative or positive correlation with the FTSE/JSE J253 indicator (r≤0.05)

Observed		*Predicted null model*			*Predicted new model*		
		SALRE		*Percentage correct*	*SALRE*		*Percentage correct*
		0	*1*		0	*1*	
SALRE	0	0	19	0	9	10	47.4
	1	0	45	100	3	42	93.3
Overall percentage				70.3			79.7

The South African model in Tables 4 to 8 is significantly a better (p<.05) fit than the null model (does not include explanatory indicators), as the omnibus test shows (chi-square=18.928, df=9, p=026). The Cox and Snell and Nagelkerke R-squared were 0.256 and 0.364, respectively, which implies that the model explains approximately 25.6% or 36.4% of the variation (changes) in the listed real-estate market. The Hosmer and Lemeshow test of the goodness of fit show that the model is a good fit to the data with p=0.757 (>.05) (p-values close to 1 indicate a good logistic regression model fit). The model has a 93.3% accuracy in predicting growth (Y=1), while it has a 47.4% accuracy in predicting a decline (Y=0). This model correctly predicts, with a 79.7% accuracy, changes in the listed real-estate market, compared to 70.3% on the null model, thus 9.4% improvement.

4.2 Nigerian model

Dependent variable: Nigeria Listed Real Estate (NLRE)

Independent variables: total GDP, prime lending/interest rate (%), the Treasury bill rate (%), the total money asset, money supply (M1), currency in circulation, and money supply (M2).

Descriptive statistics for the Nigerian logistic regression model variables are presented in Table 9.

Table 9: Descriptive statistics of Nigerian data employed in logit analysis

	Minimum	*Maximum*	*Mean*	*Std. deviation*
NSE listed property index	4145.10	4921.11	4548.48	227.73
Binary variable (NLRE)	0	1	.50	.506
Total GDP (N millions)	12583478.33	35230607.63	22098650.22	5959960.915
Prime lending/interest rate (%)	44.65	58.27	50.72	3.11
T-bill %	5.12	44.10	27.94	10.65
Total money asset	21542374.30	97307716.20	54437047.19	22378043.23
Money supply (M1)	11801598.20	33680739.24	21257092.87	6650841.91
Currency in circulation	2624429.50	6385845.91	4455189.75	1015721.20
Money supply (M2)	21542374.30	78588158.53	47817724.05	16402868.45

In Table 9, the NSE listed property indicator shows a minimum and maximum value of ₦ 4145.10 and ₦ 4921.11, respectively, with a mean of ₦ 4548.48. Its standard deviation of ₦ 227.73 represents a significantly high variation of the values from the mean. The mean of the NLRE at 0.50 and a 0.506 standard deviation show that there are almost equal number of values closer to the maximum (1) as those close to the minimum (0). Interest rates show a standard deviation from the mean of 3.11% with a maximum of 58.27% and a 44.65% minimum and a 50.72% mean value. The interest rate maintained a more stable high value compared to the South African interest rate data, which can be explained by the riskier investment market requiring higher interest rates. Meanwhile, the GDP maximum stands at 35,230,607.63 (₦ millions). GDP also has a minimum of 12,583,478.33 (₦ millions), a mean and standard deviation of 22,098,650.22 (₦ millions), and 5,959,960.91 (₦ millions), respectively. The high standard deviations indicate that the growth or change over the time period includes values that are significantly dispersed from the mean values. These values capture peaks and troughs in the time-series data and should as such demonstrate significant variations from a mean value.

Table 10: Correlation coefficient of Nigerian variables relative to NSE-listed RE Index

		NSE Listed RE Index	*Total GDP*	*Prime lending /Interest rate (%)*	*T-bill %*	*Total money asset*	*Money supply (M1)*	*Currency in circulation*	*Money supply (M2)*
NSE Listed RE Index	Pearson correlation	1	.372*	-.281	.429**	.385**	.385**	.356*	.375*
	Sig. (2-tailed)		.025	.064	.004	.010	.010	.018	.012

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

A Pearson correlation was run to assess the relationship between Nigerian economic indicators and N-REIT. In Table 10, all selected money supply variables were significant, but show low positive correlation with the listed real-estate market, total money asset [r=.385, p<.010], M1 [r=.385, p<.010], and currency in circulation [r=.356, p<.018], M2 [r=.375, p<.012]. Although the total GDP is a significant indicator [r=0.025, p=.025], it shows a very low positive correlation with the listed N-REIT index. Unlike in South Africa, the prime lending/interest rate is not a significant indicator [r=-.281, p<.064] and shows a low negative correlation with the listed real-estate market in Nigeria. Although the Treasury bill (T-bill) rate is significant, it shows a moderate correlation [r=.429, p<.004] with the listed real-estate sector.

The high multicollinearity noticed between the GDP and money supply (MI), currency in circulation, total money asset, and money supply (M2), confirms the observation that South Africa's selected economic variables also applies to Nigeria. This collinearity implies that not all economic variables contribute significantly to modelling the listed real-estate market. The logit regression model resolves the multicollinearity, by eliminating economic variables that do not explain much of the variation in the listed real estate data series.

For the Nigerian data sets, in Table 4, the Wald Z-test shows the values are not zero, which confirms that the selected indicators are significant and should be included in the model. The β (beta coefficient) allows comparison of **the relative importance** of indicators in a regression model. GDP (β=0.000, p=.036), total money asset (β=0.000, p=.043), M1 (β=0.000, p=.656), M1 (β=0.000, p=.287), currency in circulation (β=0.000, p=.129), and M2 (β=0.000, p=.012) have zero influence on, and do not predict the listed real-estate market in Nigeria. Although not significant (β=0.143, p=.666), the β value shows that the lending/interest rate predicts the listed real-estate market in Nigeria. CPI (β=-0.034, p=.695), and T-bill % (β=-0.037, p=.560), have a negative influence on, and do not predict the

listed real-estate market trends in Nigeria. This signifies that a decrease in these two economic indicators will impact negatively towards growth in the listed real-estate market.

Table 11: Significant indicators accepted in the Nigeria Logistic regression

Indicator	*B (beta)*	*S.E. (standard error)*	*Wald*	*Df*	*Sig.*
Total GDP	.000	.000	4.419	1	.036
Composite Consumer Price Index (%)	-.034	.086	.153	1	.695
Prime lending/interest rate (%)	.143	.331	.187	1	.666
T-bill %	-.037	.064	.339	1	.560
Total money asset	.000	.000	4.087	1	.043
Money supply (M1)	.000	.000	.198	1	.656
Currency in circulation	.000	.000	2.307	1	.129
Money supply (M2)	.000	.000	6.249	1	.012
Constant	-21.938	21.429	1.048	1	.306

* significant at the 0.05 level

The tests for significance of the Nigerian model are shown in Tables 12 to 15.

Table 12: Omnibus test of Logit Regression Model for Nigerian indicators (r≤0.05)

	Chi-square	*Df*	*Sig.*
Step	20.875	8	.007
Block	20.875	8	.007
Model	20.875	8	.007

Table 13: Pseudo-R values for the full model including all Nigerian indicators (r≤0.05)

-2 Log likelihood	*Cox & Snell R-square*	*NagelkerkeR-square*
28.920	.440	.587

Table 14: Hosmer and Lemeshow's goodness of fit test for the full model, including all Nigerian indicators

Chi-square	*Df*	*Sig.*
3.599	7	.825

Table 15: Classification table for the null and full model including all Nigerian indicators

Observed		Predicted null model			Predicted new model		
		SALRE		Percentage correct	SALRE		Percentage correct
		0	1		0	1	
NLRE	0	0	17	0	12	5	70.6
	1	0	19	100	4	15	78.9
Overall percentage				52.8			75.0

The Nigerian model in Tables 12 to 15 is significantly a better (p<.05) fit than the null model (does not include explanatory indicators), as the omnibus test shows (chi-square=20.875, df=8, p=007). The Cox and Snell and Nagelkerke R-squared were 0.440 and 0.587, respectively, which implies that the model explains approximately 44.0% or 58.7% of the variation (changes) in the listed real-estate market. The Hosmer and Lemeshow test of goodness of fit shows that the model is a good fit to the data with p=0.825 (>.05) (p-values close to 1 indicate a good logistic regression model fit). The model has a 78.9% accuracy in predicting growth (Y=1), while it has a 70.6% accuracy in predicting a decline (Y=0). This model correctly predicts the outcome for 75% of the changes in the market, which is a 22.2% increase from 52.8% recorded in the null model.

5. DISCUSSION

5.1 South African model

The supply of money and cash in circulation, as well as increasing money deposits indicate the availability of liquidity within the South African economy for long-term investments in commercial real estate and similar alternatives. The data shows that monetary supply variables are significant contributors to commercial real-estate pricing models. Money supply variables were found to be significant predictors of the South African listed real-estate market. This was to be expected, given that real estate is a capital-intensive venture. The listed real-estate instruments, being a significant source of financing for actual real-estate supply, are affected significantly by the money supply. Simo-Kengne, Balcilar, Gupta, Reid & Aye (2012) also agreed that monetary policy is not neutral, as house prices decrease substantially as a result of a contractionary monetary policy.

Business indicators: leading, lagging and coincident, within the South African context are relied on for confirming the direction of the overall economy. However, the business leading indicators have been criticised regarding their accuracy and reliability, as noted in Boshoff and Binge (2019). The study found only the coincident indicator (gross value added at constant

prices – see 3.3.2.ii) contributed significantly to explaining variations in the South African listed real-estate market. The leading indicator series also indicates relatively high collinearity with other independent variables, which implies that the variance it adds to the dependent variable (SALRE) is not significant.

The GDP has a strong correlation coefficient, which presents it as a strong economic indicator for price discovery and forecasting the South African listed real-estate market. As production increases, economies tend to experience growth in employment and subsequent demand for commercial office space. The GDP, as a major economic indicator, is bound to affect the spending capacity and general sentiments regarding long-term investment in commercial real estate. A growing GDP would signify growing interests in commercial properties, offices, warehouses, shopping centres, and serviced apartments. A strong positive correlation with the exchange rate indicates that strong growth in FDI and demand for local currency or other expansionary foreign policies would stimulate growth in the South African listed real-estate market.

The cost of capital has a moderately strong positive relationship with the listed real-estate market in South Africa. The higher cost of capital implies an increased risk for direct real-estate investment, which makes indirect real estate an attractive alternative. Indirect or listed real-estate instruments would appreciate, as the increasing costs of capital implies that developers would require other sources of capital than bank loans.

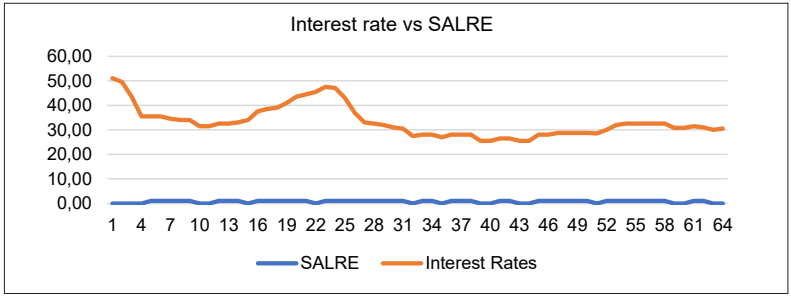

Figure 1: Time series of the South African interest rate compared to the South African Listed Real Estate Index

Figure 1 shows that the South African bank lending rate also indicates similar growth and fall patterns with the corresponding SALRE index from 1 January 2003 to 31 December 2018. This does not suggest causality, but is still a good indicator for investment.

5.2 Nigerian model

The test for correlation was also conducted on Nigerian data. All the independent variables proved statistically significant at the 0.05 level, except the lending or interest rate, which had a P-value of .064. The interest rate also had a low negative correlation of p=-.281 with the dependent variable. This implies that the regime of the lending rate over the years had a negative correlation and an insignificant impact on the listed real-estate market. This result aligns with the findings of Olanrele, Said, Daud and Ab (2015) that REITs are sensitive to interest rates, but with insignificant effect.

The prime lending rate or interest rate has a low negative correlation of p=-0.281, but, unlike the case in South Africa, it proves insignificant to the dependent variable.

As in South Africa, money supply variables including total money asset, money supply (M1), currency in circulation, and money supply (M2) all have a positive significant correlation with the listed real-estate market.

GDP shows a low positive correlation with the listed N-REIT index, which indicates that a large increase in GDP would lead to growth in the listed real-estate pricing. The Treasury bill rates would cause increases in listed real-estate or N-REIT share prices. This indicates that an increasing Treasury bill rate would have growth value for the real estate market in Nigeria.

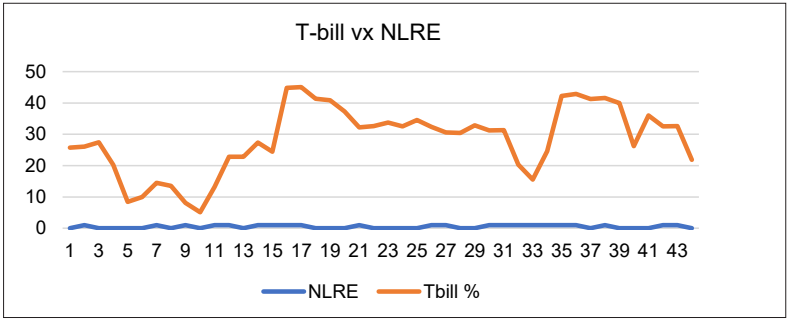

Figure 2: Time series of the Nigerian T-bill rate compared to the NSE Listed Property Index.

The Nigerian T-bill rate indicates the government's monetary policies. In Figure 2, the growth and fall pattern of the two series (for the period 1 January 2008 to 31 December 2018, except for 2013 and 2015) align to indicate similar patterns. Nigeria's listed real and the T-bill rate share a common historical growth pattern. This similarity implies that general inferences can be made about the growth of the NLRE based on the policy decisions on the T-bill rate.

The study concluded that not all economic indicators lead to changes in price movements in the listed real-estate market in South Africa and Nigeria. However, a combination of some of these significant variables help explain variations in the listed real-estate indicator. The best-fitted models in South Africa and Nigeria also perform well in classifying the in-sample data. Therefore, in relation to real-estate investment within the two leading economies, the market indicators do not altogether reveal negativity. Hence, local and international real-estate investors can still undertake investments in the two countries, but careful feasibility and viability analyses must precede the decision.

6. CONCLUSION

This study used the logit regression modelling framework to identify the leading economic variables for predicting changes in the rental values of commercial real estate in Nigeria and South Africa. The goal was to use these macroeconomic indicators to understand the real-estate market behaviour of these two economies, so that real-estate investors could from their performance plan possible investments. Thus, related and contrasting variables that are common to these markets were used to explain future trajectory and early warning signals.

After a careful assessment of these macroeconomic market indicators, their performance reveals a positive outlook for the Nigerian and South African real-estate market, although at a varying level of acceptability, despite the recent negative image of the two markets. This potentially reduces the risk and uncertainty associated with participation in the real-estate markets of emerging African economies such as Nigeria and South Africa.

Further study could be done towards understanding predictive probabilistic models, as there is a need to evaluate the accuracy they add to real-estate market analysis and reporting. Further research could also be conducted on how econometric models should fit into business reporting for residential and commercial real-estate companies. This would make it possible to evaluate data on real-estate performance, based on consistent data sources such as listed real-estate data.

REFERENCES

Akinsomi, O., Mkhabela, N. & Taderera, M. 2018. The role of macro-economic indicators in explaining direct commercial real estate returns: Evidence from South Africa. *Journal of Property Research,* 35(1), pp. 28-52. https://doi.org/10.1080/09599916.2017.1402071

Baba, C. & Kisinbay, T. 2011. Predicting recessions: A new approach for identifying leading indicators and forecast combinations. IMF Working Paper WP/11/235. https://doi.org/10.5089/9781463922016.001

Bodunrin, O.S. 2019. The impact of fiscal and monetary policy on Nigerian economic growth. *Munich Personal RePEc Archive*, 92811.

Boshoff, D. 2013. Towards a listed real estate investment alternative hypothesis. *South African Journal of Economic and Management Sciences*, 16(3), pp. 329-346. https://doi.org/10.4102/sajems.v16i3.422

Boshoff, W. & Binge, L. 2019 Alternative cycle indicators for the South African business cycle. In: Smirnov, S., Ozyildirim, A. & Picchetti, P. (Eds). *Business cycles in BRICS*. Switzerland: Springer, pp. 447-464. https://doi.org/10.1007/978-3-319-90017-9_27

BudgIT. 2018. Structure of the Nigerian economy, state of the economy. [Online]. Available at: <https://yourbudgit.com/economy/> [Accessed: 23 January 2020].

Buehler, M.M. & Almeida, P.R. 2016 Understanding the commercial real estate investment ecosystem. An early warning system prototype (No. World Economic Forum REF 080116).

Clark, A. & Daniel, T. 2006. Forecasting South African house prices. *Investment Analysts Journal*, 35(64), pp. 27-33. https://doi.org/10.1080/10293523.2006.11082482

D'Arcy, E., McGough, T. & Tsolacos, S. 1999. An econometric analysis and forecasts of the office rental cycle in the Dublin area. *Journal of Property Research*, 16(4), 309-321. https://doi.org/10.1080/095999199368067

Emerole, C.G. 2018. Risks and opportunities in emerging markets international real estate investment: A comparative analysis of Nigeria and South Africa. *Journal of the Nigerian Institution of Estate Surveyors and Valuers*, 41(1), pp. 71-78.

Frankel, J. & Saravelos, G. 2012. Can leading indicators assess country vulnerability? Evidence from the 2008-2009 global financial crisis. *Journal of International Economics* 87(2), pp. 216-231. https://doi.org/10.1016/j.jinteco.2011.12.009

Füss, R., Stein, M. & Zietz, J. 2012. A regime-switching approach to modeling rental prices of UK real estate sectors. *Real Estate Economics*, 40(2), pp. 317-350. https://doi.org/10.1111/j.1540-6229.2011.00316.x

Harrami, H. & Paulsson, O. 2017. Rent modelling of Swedish office markets: Forecasting and rent effects. Unpublished Master thesis. Royal Institute of Technology, Stockholm, Sweden.

Jadevicius, A., Sloan, B. & Brown, A. 2013. Property market modelling and forecasting: A case for simplicity. In: *20th Annual European Real Estate Society Conference*, 3-6 July, Vienna, Austria. [Online]. Available at: <http://eres.scix.net/data/works/att/eres2013_10.content.pdf> [Accessed: 23 January 2020].

Karakozova, O. 2004. Modelling and forecasting office returns in the Helsinki area. *Journal of Property Research*, 21(1), pp. 51-73. https://doi.org/10.1080/0959991042000254579

Krystalogianni, A., Matysiak, G. & Tsolacos, S. 2004. Forecasting UK commercial real estate cycle phases with leading indicators: A probit approach, *Applied Economics*, 36(20), pp. 2347-2356. https://doi.org/10.1080/0003684042000280544

MacFarlane, J., Murray, J., Parker, D. & Peng, V. 2002. Forecasting property market cycles: An application of the RICS model to the Sydney CBD office market. In: *Proceedings of the 8th Pacific Rim Real Estate Society Conference* 21-23 January, Christchurch, New Zealand, pp. 1-19.

Michael, B. & Almeida, P. 2016. Understanding the commercial real estate investment ecosystem. An early warning system prototype. *World Economic Forum REF 080116*.

Monde, M. 2008. The turning of the cycle and the impact of interest rates. In: *4th Convention of the South African Institute of Black Property Practitioners (SAIBPP)*. 31 July, Midrand, South Africa: South African Institute of Black Property Practitioners (SAIBPP).

Moolman, E. & Jordaan, J. 2005. Can leading business cycle indicators predict the direction of the South African commercial-share price index? *The South African Journal of Economics*, 73(1), pp. 68-78. https://doi.org/10.1111/j.1813-6982.2005.00005.x

Mourouzi-Sivitanidou, R. 2020. Real estate economics. In: Sivitanides, P. (Ed.). *Market analysis for real estate*. New York: Routledge, e-book. https://doi.org/10.4324/9780429279409

Namnso, U., Ighalo, J. & Sanusi, Y. 2015. Modelling the office rental market in selected districts of Abuja. *De Gruyter*, 7(28), pp. 64-72.

NCSS. 2020. Logistic regression. In: NCSS Statistical Software, pp. 1-69. [Online]. Available at: <https://ncss-wpengine.netdna-ssl.com/wp-content/themes/ncss/pdf/Procedures/NCSS/Logistic_Regression.pdf> [Accessed: 2 January 2020].

Ng, B.F. & Higgins, D. 2007. Modelling the commercial property market: An empirical study of the Singapore office market. *Pacific Rim Property Research Journal*, 13(2), pp. 176-193. https://doi.org/10.1080/14445921.2007.11104229

Ntuli, M. & Akinsomi, O. 2017. An overview of the initial performance of the South African REIT market. *Journal of Real Estate Literature*, 25(2), pp. 365-388.

Olanrele, O.O., Adegunle, T.O., Fateye, O.B. & Ajayi, C.A. 2019. Causal relationship between N-REIT's dividend yield and money market indicators. *Journal of African Real Estate Research*, 4(1), pp. 71-91. https://doi.org/10.15396/afres2018_145

Olanrele, O.O., Said, R. & Daud, N. 2015. Comparison of REIT dividend performance in Nigeria and Malaysia. *African Journal of Business Management*, 9(16), pp. 608-614. https://doi.org/10.5897/AJBM2015.7855

Organisation for Economic Co-operation and Development (OECD). 2018. Gross domestic product (GDP), OECD Data. [Online]. Available at: <https://data.oecd.org/gdp/gross-domestic-product-gdp.htm> [Accessed: 24 January 2020].

PwC. 2015. Building the future of Africa. March, p. 85. [Online]. Available at: <www.pwc.co.za/realestate> [Accessed: 2 January 2020].

SA Commercial Prop News. 2019. Real estate and finance the star of South Africa's GDP. SA Commercial Prop News. [Online]. Available at: <http://www.sacommercialpropnews.co.za/south-africa-economy/8936-real-estate-industry-the-star-of-gdp.html> [Accessed: 23 January 2020].

Sibanda, M. 2013 The interaction between property returns and the macroeconomy: Evidence from South Africa. *International Journal of Business and Social Research*, 3(4), pp. 146-152.

Simo-Kengne, B.D., Balcilar, M., Gupta, R., Reid, M. & Aye, G.C. 2012. Is the relationship between monetary policy and house prices asymmetric in South Africa? Evidence from a Markov-Switching Vector Autoregressive Model. *Stellenbosch Economic Working Papers*, pp. 15-26. Matieland, South Africa. [Online]. Available at: <https://ideas.repec.org/p/pre/wpaper/201222.html> [Accessed: 2 January 2020].

Tsolacos, S. 2006. An assessment of property performance forecasts: Consensus versus econometric. *Journal of Property Investment and Finance*, 24(5), pp. 386-399. https://doi.org/10.1108/14635780610691896

Tsolacos, S. 2012. The role of sentiment indicators for real estate market forecasting. *Journal of European Real Estate Research*, 5(2), pp. 109-120. https://doi.org/10.1108/17539261211250690

Tsolacos, S. & Brooks, C. 2010. *Real estate modelling and forecasting*. New York: Cambridge University Press.

Tsolacos, S., Brooks, C. & Nneji, O. 2014. On the predictive content of leading indicators: The case of US real estate markets. *Journal of Real Estate Research*, 36(4), pp. 541-573. https://doi.org/10.2139/ssrn.2233085

Van Der Walt, B.E. & Pretorius, W.S. 2004. Notes on revision of the composite business cycle indicators. *South African Reserve Bank Quarterly Bulletin*, pp. 29-35.